



U.S. Department of Transportation
Federal Railroad Administration

IDOT PTC

Terry Tse
Program Manager – Advanced Train Control



FRA/RDV Project Objectives

- ◆ **Alternative of 49CFR236.0.d to allow safe 110 mph operation in passenger/freight mixed territory**
- ◆ **Develop Interoperability Standards with**
 - Non-Proprietary Design
 - Open Standard
 - System extensibility
- ◆ **Demonstrate flexible block operation with an Office Centric System**
- ◆ **Promote vital, fail-safe, and close loop design**
- ◆ **Accelerate development and adoption of advanced train control system**
- ◆ **Use as a test case of NPRM for micro-processor based train control system**

North American Joint Positive Train Control (NAJPTC) Program

March 2, 2005 – NTSB PTC Symposium

Alan Polivka

Assistant Vice President

Communications and Train Control Technologies

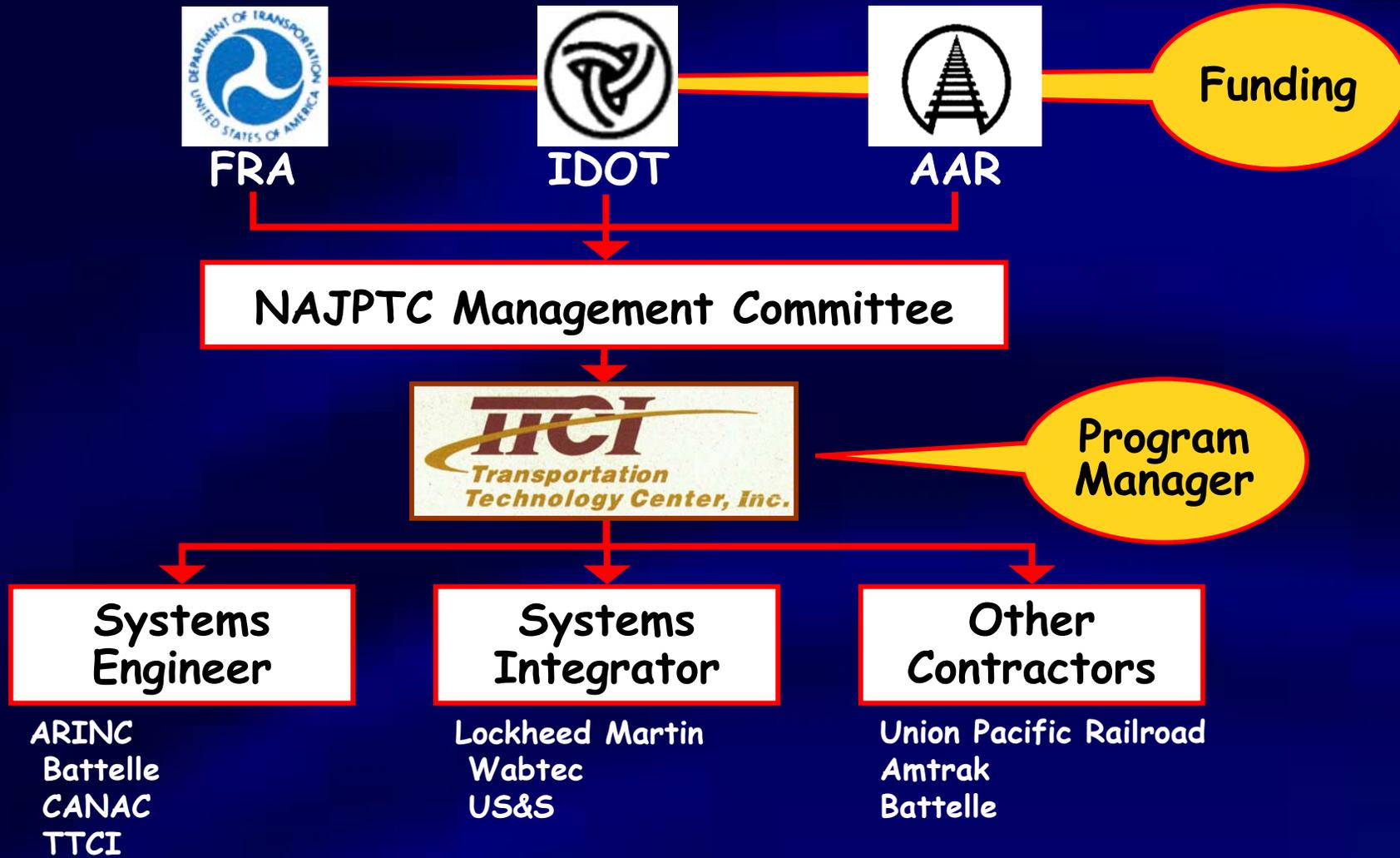
General Manager – NAJPTC Program

Transportation Technology Center, Inc.

Pueblo, Colorado - USA



NAJPTC Program Management



Pooled resources are sponsoring the program

NAJPTC Project Objectives

- ◆ **Demonstrate PTC Safety Functionality**
 - Prevent Train-to-Train Collisions
 - Enforce Speed Restrictions
 - Protect Roadway Workers operating under Specific Authorities

- ◆ **Develop Interoperability Standards**
 - Non-Proprietary Design
 - Railroads Own the Design (including source code)

- ◆ **Produce Cost-Effective design**
 - Maximum use of COTS components

- ◆ **Develop Revenue-Ready System for High Speed Passenger Trains Intermixed with Freight Trains**

System Features

- ◆ **Warnings / Enforcement of Authorities and Speeds**
- ◆ **Modular Design – for tailored or evolutionary deployment**
- ◆ **Locomotive Activation of Highway Crossing Warning Systems**
 - *Eliminates need to extend crossing track circuits for high speed operation*
- ◆ **Fail-safe (Vital) implementation & Moving Block**
 - *Potential to reduce delay during overtakes & recovery from disruptions*
 - *Potential to increase capacity without adding track*
 - *Potential to alleviate need for wayside signals*
 - *Enables high speed (passenger) train operation*
- ◆ **Open, non-proprietary design – for interoperability & lower recurring cost**
- ◆ **Remote Control of Switches from Locomotive**
- ◆ **Boundary Protection**
- ◆ **Handling of Equipped and Unequipped trains on same track**
- ◆ **Detection, Reporting, & Protection against Rogues & Emergencies**
- ◆ **Remote Monitoring of Train Locations and Movements**
- ◆ **Potential for Paperless Bulletins and Authorities**

NAJPTC Architecture and Operation

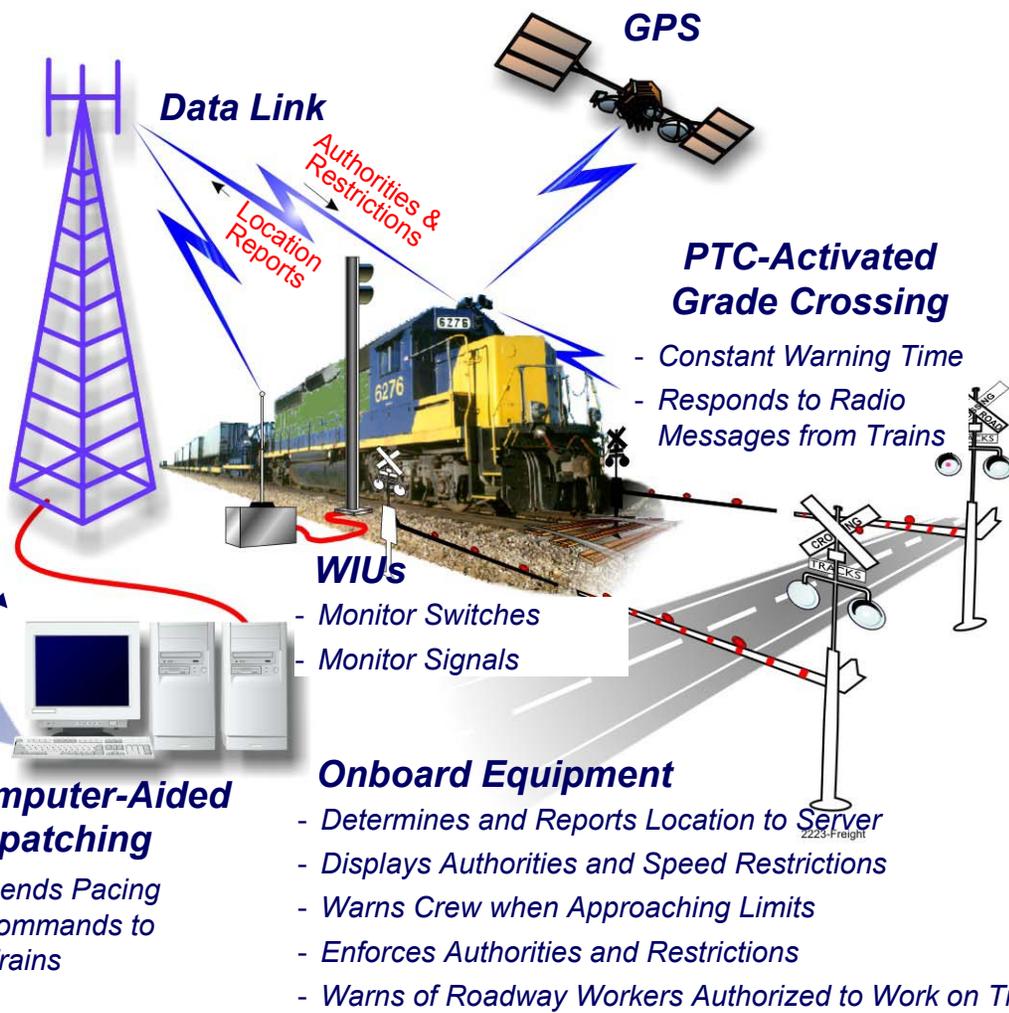
PTC Office Server

- Tracks Trains closely
- Monitors Field Conditions
 - Track Circuits
 - Switches
 - Defects Detectors
- Computes & Checks Authority Limits
- Transmits Movement Authorities & Speed Restrictions to Trains



Computer-Aided Dispatching

- Sends Pacing commands to Trains



Data Link

Location Reports
Authorities & Restrictions

GPS

PTC-Activated Grade Crossing

- Constant Warning Time
- Responds to Radio Messages from Trains

WIUs

- Monitor Switches
- Monitor Signals

Onboard Equipment

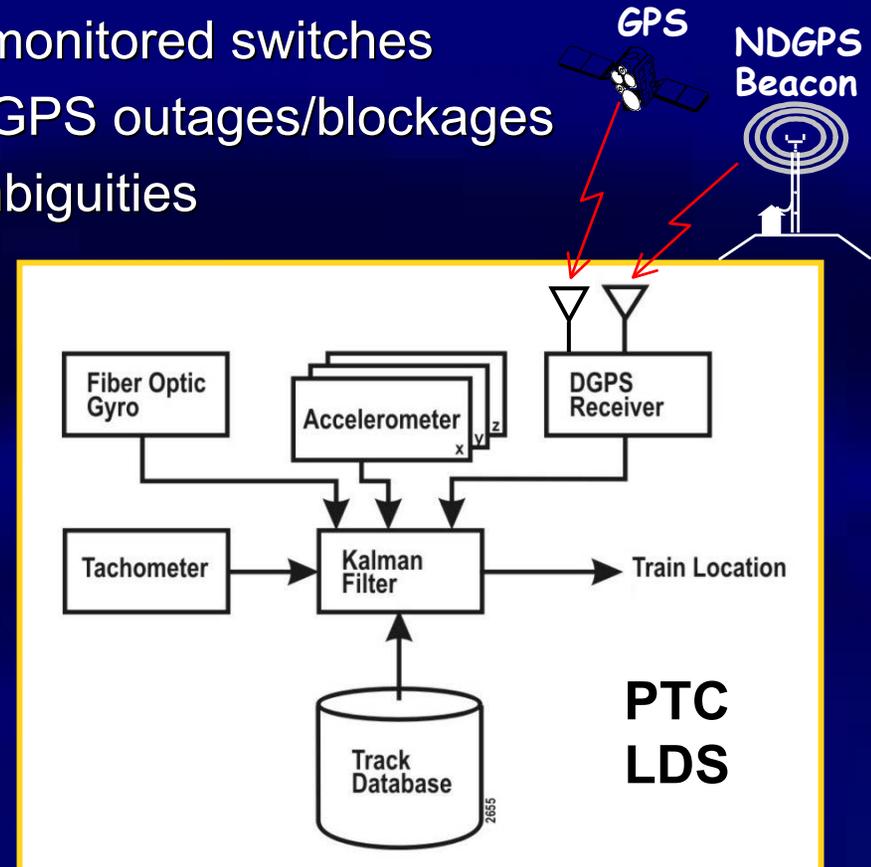
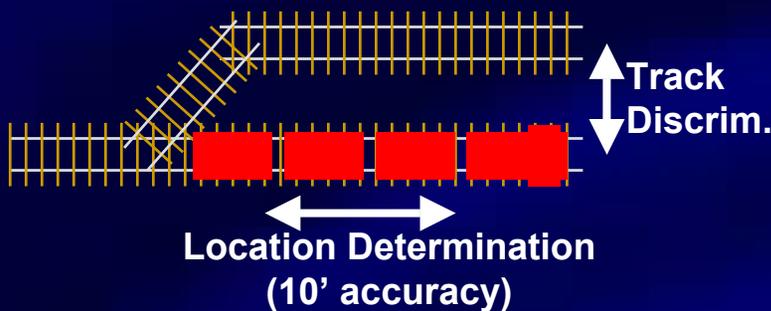
- Determines and Reports Location to Server
- Displays Authorities and Speed Restrictions
- Warns Crew when Approaching Limits
- Enforces Authorities and Restrictions
- Warns of Roadway Workers Authorized to Work on Track

Office Server checks All Authorities and Restrictions for potential Conflicts

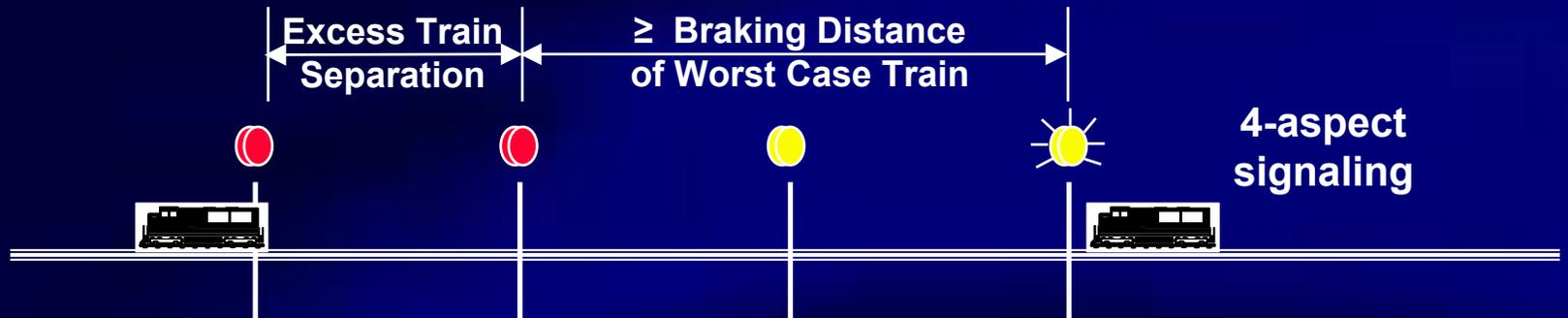
Location Determination System (LDS)

◆ NAJPTC uses a Multi-Sensor LDS which offers the following advantages over DGPS and Tachometer alone:

- Lower probability of discrimination error which can cause unnecessary train stops at unmonitored switches
- Dead reckons through longer GPS outages/blockages
- Eliminates forward/reverse ambiguities
- Permits tighter fit in sidings
- Improved fault detection



NAJPTC includes Moving Block



**Integrated Territory
(Fixed Block Overlay)**

Direction of Movement

**Standalone Territory
(Moving Block)**

Vital Implementation & Precise Train Location allow Moving Block operation.

UP Track – Amtrak also uses



Illinois Dept. of Transportation (IDOT) PTC Corridor



Vitality

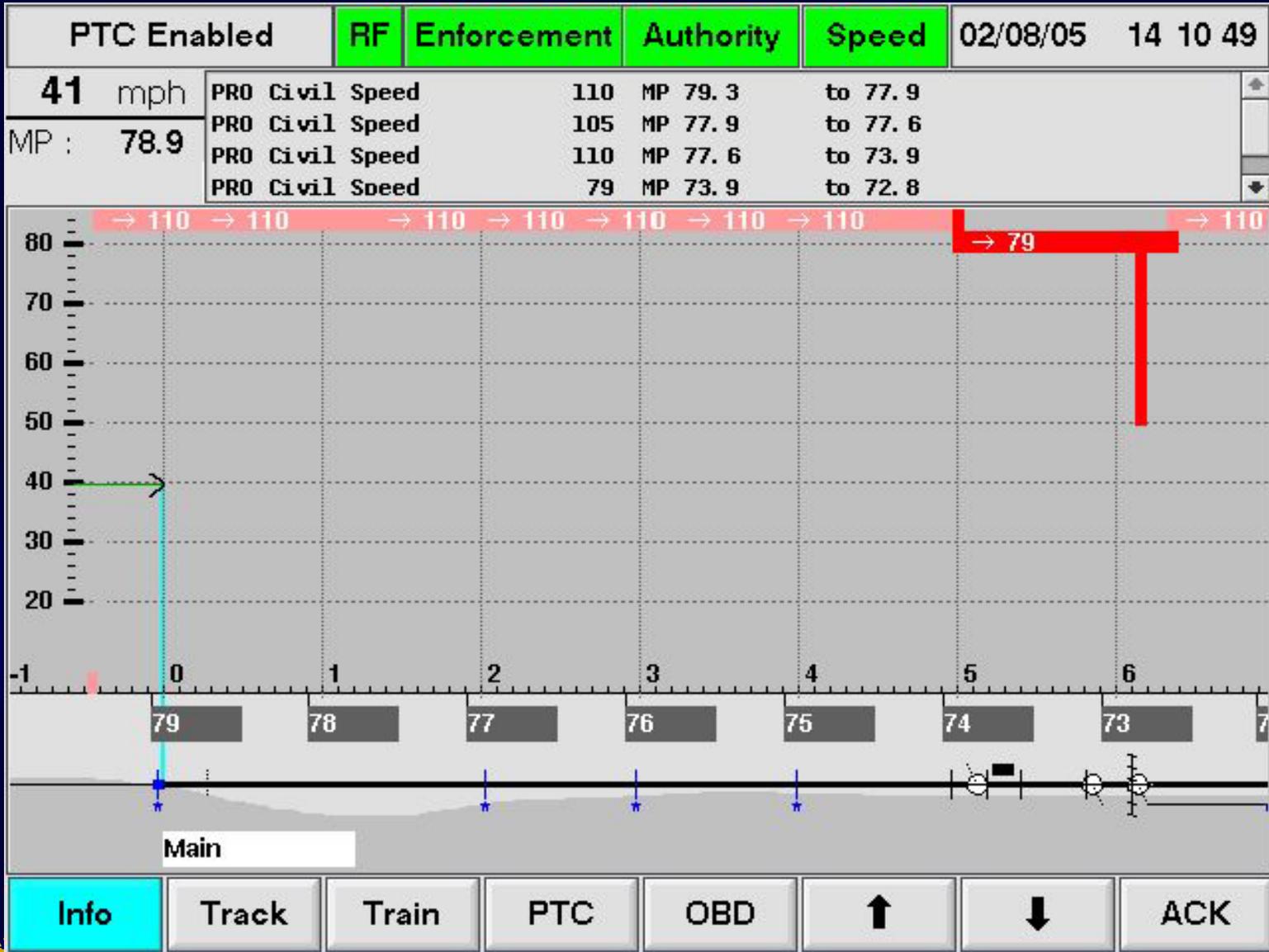
- ◆ **Vital systems have a high enough level of Safety Integrity to Stand Alone where Traffic Densities are High and/or Speeds exceed 49 mph (freight) or 59 mph (passenger).**
- ◆ **Vital functions are required to be implemented in a fail-safe manner.**
 - Failure coverage must be comprehensive
 - Fail-safe response must be timely

NAJPTC Approach to Vitality

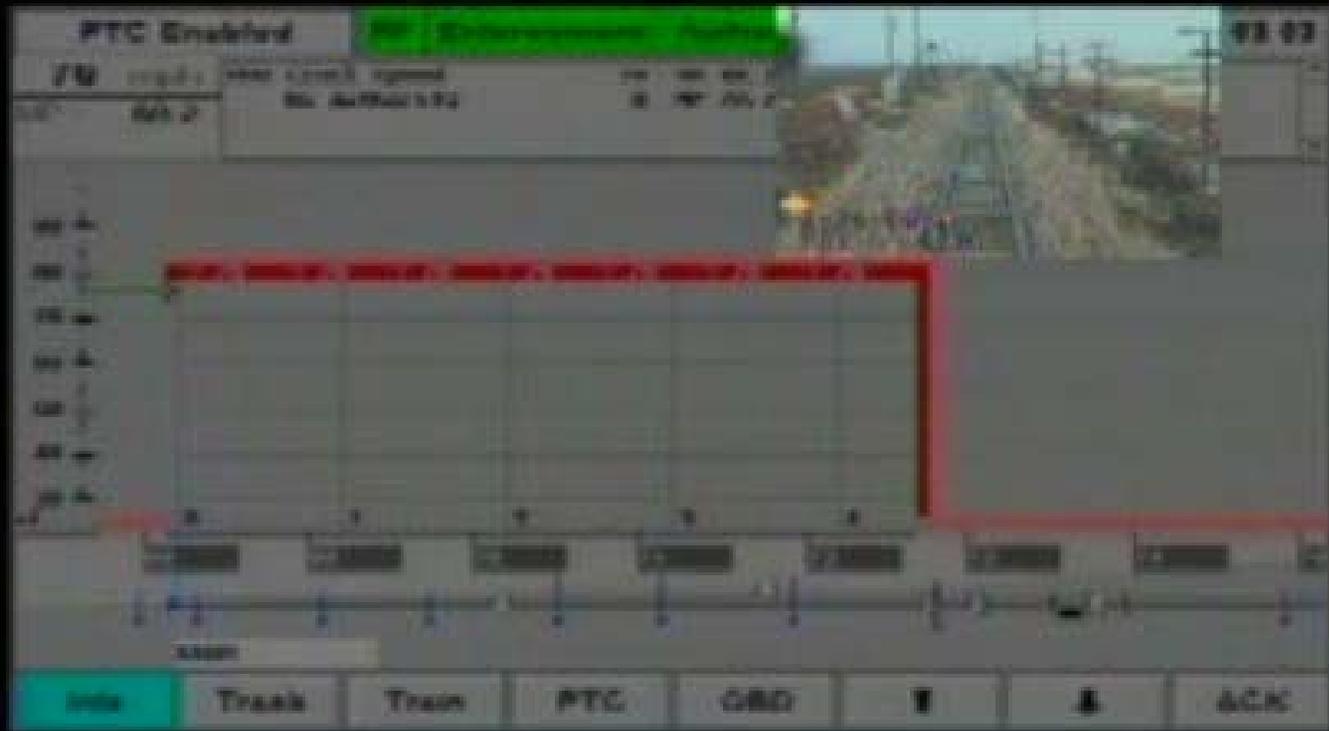
- ◆ **Extensive Safety Analysis (PHA/HazLog, SRD, FFT, FTA, SSHA, FMEA, O&SHA)**
- ◆ **Automatic Mitigations to Fault Hazards (SAC) Designed-in (Fail-Safe via Redundancy, Diversity, Closed Loop, Heartbeats, etc.)**
- ◆ **V&V (Multi-Level Testing, Demonstration, Analysis, Inspection, PCA, FCA, Full Safety Traceability)**
- ◆ **Safe Operating and Maintenance Procedures**
- ◆ **3rd Party Assessment**
- ◆ **Risk Analysis (ASCAP, Quantitative FTA)**
- ◆ **Safety Case (PSP) per NPRM & RSPP**

Multifaceted Approach

Onboard Display



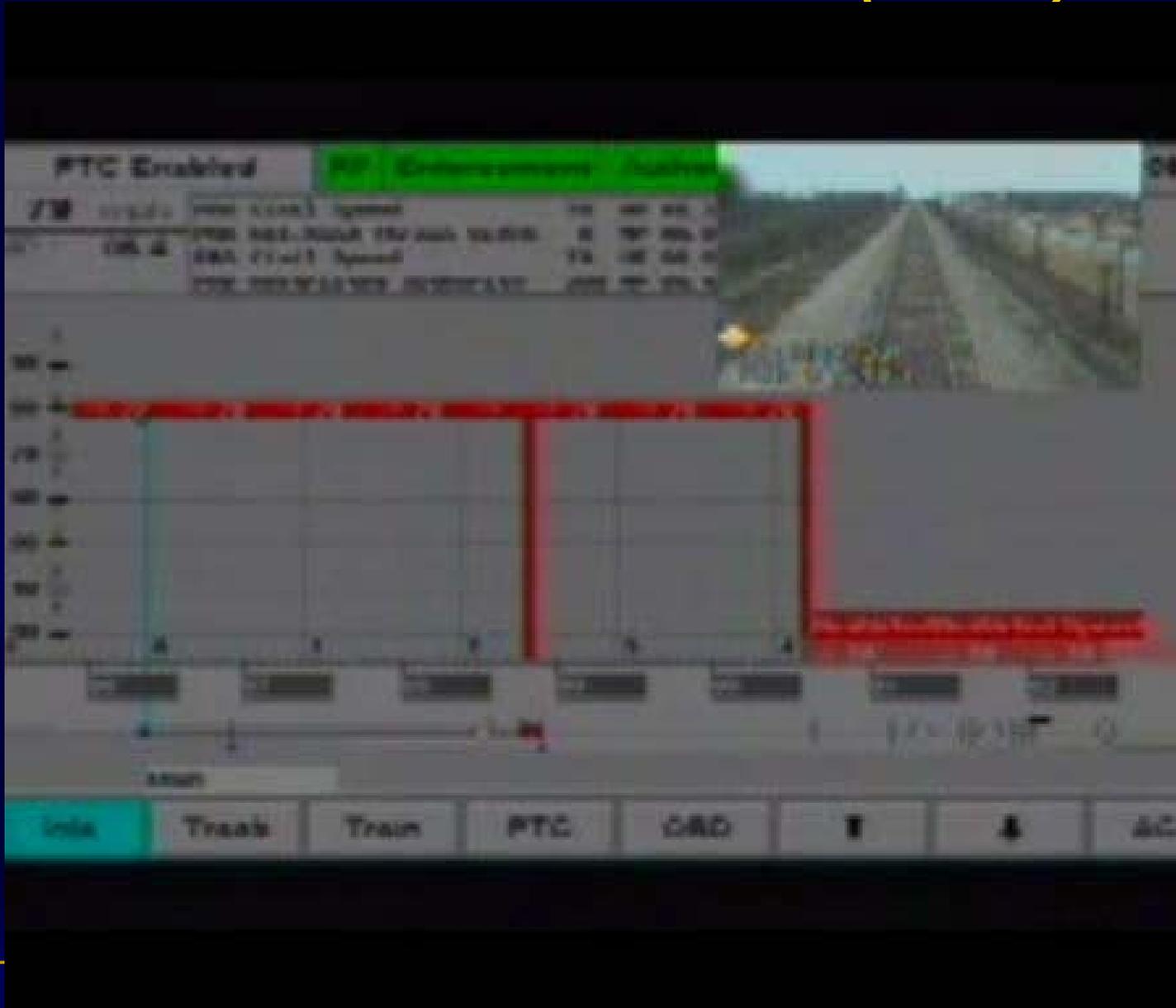
Onboard Display in Action (video)



Following Move in Action (video)



Enforcement in Action (video)



Digital Delivery and Onboard Display of Forms-based Authorities and Bulletins

PTC Enabled	RF	Enforcement	Authority	Speed	02/09/05	14:18:33
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0.0 mph	PRO Civil Speed	79	MP 73.1	to 72.8
MP : 73.1	PRO Civil Speed	50	MP 72.8	to 72.8
	PRO Civil Speed	79	MP 72.8	to 72.6
	PRO Civil Speed	110	MP 72.6	to 70.3

Form B

Form B Information:

Dispatch Bulletin # MOW001 Dispatch Line #: 01

from MP 69.00 to MP 66.00

EIC ID / Gang #: A Richead

Start: 12: 21 02/09/2005 End: 23: 17 02/09/2005

Stop Required

Flags : None

Special Instructions:

 now 01

Close

Info	Track	Train	PTC	OBD	↑	↓	ACK
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NAJPTC Summary

- ◆ **Modular Vital Train Control Implementation provides Flexibility for Tailoring to Near Term Needs with 100% Re-Use in Long Term Applications**
- ◆ **Non-Proprietary Hardware and Software Minimizes Recurring Cost and facilitates Interoperability**
- ◆ **High Performance Location Determination System Reduces potential Operational Impacts of GPS Loss, Location Inaccuracies, and Track Discrimination Errors**